

THURSDAY, JANUARY 10, 1884

AMERICAN GEOLOGY

Twelfth Annual Report of the United States Geological and Geographical Survey of the Territories. In Two Parts, with Atlas of Maps, &c. By F. V. Hayden, U.S. Geologist. 8vo. (Washington: 1883.)

THERE is a singular fascination in American geology. Its features are as a whole so massive and colossal, their infinite detail so subordinated to breadth of effect, their presentation of the great elements of geological structure so grand, yet so simple and so clearly legible, that they may serve as types for elucidating the rest of the world. The progress of sound geology would assuredly have been more rapid had the science made its start in the Far West of America, rather than among the crumpled and broken rocks of Western Europe. Truths that have been gained on this side of the Atlantic by the laborious gathering together of a broken chain of evidence would have proclaimed themselves from thousands of plateaux, cañons, and mountain ranges, in language too plain to be mistaken. No doubt much has been gained by the mere toilsomeness of the search after the truth. A possession is more valued when it has been hard to obtain, and the qualities which its capture has called forth and strengthened could probably be educated in no other way. Nevertheless, no European geologist can visit these western regions without realizing more or less distinctly what an amount of time has been wasted here over questions about which there should never have been any discussion at all. This impression is renewed by every new geological memoir which brings to us fresh revelations of the scenery and structure of the Western Territories. It is especially deepened by a perusal of the volumes of which a brief notice will here be given.

It may be in the recollection of readers of NATURE that after some inquiry and discussion it was discovered by the Congress of the United States that various independent Surveys, under different Government departments, had been engaged among the Western Territories, and, having no connexion with each other, had, to some extent, duplicated the mapping of the same ground; and that at last in the summer of 1879 a law was passed whereby these various geological and topographical Surveys were abolished, and a new single organization was created under the name of the "Geological Survey of the United States." One of the Surveys thus abolished was known as "the U. S. Geological and Geographical Survey of the Territories," under Dr. F. V. Hayden as Geologist in charge. The publications of this Survey comprised a voluminous series of annual Reports and Bulletins, quarto volumes of elaborate and well illustrated Memoirs, and Geological Maps and Sections. Many thousands of square miles of country had been examined by the staff, and had been mapped and described in such a way as to lay out the broad features of wild regions for the first time, not only for the assistance of the geologist or geological surveyor who might afterwards care to fill in the details and improve the mapping, but for the guidance of future settlers in the far west, and of the Central authorities who have charge of the public

VOL. XXIX.—NO. 741

lands. When, at the bidding of Congress, Dr. Hayden's Survey organization ceased to exist and his staff dispersed in search of other occupations, the work done in the year 1878 had not been published, while several important works were in progress. A small appropriation was granted to enable him to bring out his last Report and to complete other office-work of the Survey. This grant was exhausted in the summer of 1882, leaving five quarto volumes still unpublished though far advanced towards completion. These have been handed over to the Director of the Geological Survey, to be finished and published under his auspices. The final Annual Report, however, being the twelfth of the series, has at last been issued, the delay in its appearance having arisen from the scattering of the staff and their employment in other avocations, but partly perhaps (though he makes no mention of it) to the prolonged indisposition under which Dr. Hayden has been labouring ever since his retirement from official life.

Dr. Hayden's Report for 1878 is a most fitting termination to the series which it closes. It consists of two massive octavo volumes with an atlas of Maps and Panoramas, and is profusely illustrated with plates. It is of course impossible to give any adequate notice of this elaborate work within the limits permissible in these pages. But a mere outline of its contents may afford some idea of the nature and importance of this latest contribution to American Geology.

The first volume opens with a Prefatory Letter from Dr. Hayden himself, stating briefly the arrangement of the work under his supervision during the last year of its progress. One of his parties was charged with the primary triangulation of the entire area to be surveyed, and made satisfactory progress, among the Wind River and adjacent ranges westwards to Henry's Lake, where its operations were unfortunately cut short by Indians who crossing its trail, carried off all its animals and a portion of its outfit. Not far to the north lay the Yellowstone Park—an area perpetually exempted from settlement by special Act of Congress. That wild tract, surrounded by rugged mountains, formed a natural retreat for bands of hostile Indians when pursued by troops. Only the year before, the Nez Percés, retreating from General Howard, broke into the region, killing and plundering as they went. No wonder the surveyors should excuse any shortcomings in their work by pleading "that peculiar mental condition consequent on the uncertain and exaggerated rumours relative to the movements of the hostile Bannacks by whom the country was said to be overrun, but of whose presence we saw no more than the traces of some days' old trails." Next year, the writer of these lines, having previously heard similar wild rumours, passed over some of the same ground, but actually encountered an armed party, and will always remember the "peculiar mental condition," which the dust-cloud of the approaching red-skins awakened.

A second division of the staff made a detailed survey of the Yellowstone Park, obtaining materials for a Map of it on the scale of one inch to a mile. Mr. W. H. Holmes, attached to this party, had excellent opportunity for wielding that facile pencil to which geological science is so much indebted. Dr. A. C. Peale and Mr. Musbach made a detailed study of the thermal springs for which the region is now so famous.

A third division surveyed the previously little known but

M

magnificent snowy range of the Wind River Mountains, in which three true glaciers were observed—the first known to occur east of the Coast Range of the Pacific border.

The Report of these various surveys and of palæontological and natural history researches connected with previous explorations is divided into two parts. Taking the second part first, we have a stout volume of some 500 pages with 80 plates, besides figures, maps, and sections entirely devoted to the Yellowstone Park. A good deal has been written on the wonders of this region, chiefly in previous Reports of Dr. Hayden's Surveys, and sometimes in considerable detail, as, in Professor Comstock's Report, accompanying Captain Jones' Reconnaissance published in 1875. But no such minutely circumstantial narrative has ever appeared as that now issued.

An exceedingly erroneous general impression is conveyed by the word "Park" which has been applied to this region and which has received the sanction of an Act of Congress. The tract comprises an area of upwards of 3500 square miles, most of it being forest covered and of a rugged mountainous character. Some of the peaks rise to between 10,000 and 11,000 feet above the sea. Between the lower ridges, open glades of park-like woodlands make one half forget for a while the great altitude and remoteness of the region, till the true character of the place is recalled by some pine-trunk deeply scored by a passing bear or by a herd of "antelopes" or an occasional "elk" scampering across the sunshine into the gloom and silence of the surrounding forest. Through this region, the Yellowstone River and its tributaries, draining a series of lakes, flows northward till it enters a profound cañon in which, at times unseen and unheard, it chafes the feet of volcanic precipices until, emerging amid a series of glacier moraines, it passes out of the "Park" into the Territory of Montana.

The Monograph of this deeply interesting region now published by Dr. Hayden is composed of three unequal sections. The first of these, by Mr. W. H. Holmes, treats of the general geology. It is no disparagement to the author to say that the most valuable part of his Report is to be found in his admirable sketches. He adds some interesting particulars, indeed, to what was already known of the geology of the district. For example he has worked out in greater detail the structure of Cinnabar Mountain which forms so striking a feature in the ascent of the Yellowstone above the second cañon, likewise the geology of the remarkable volcanic plateau of which one sees a section from the camping ground at the Mammoth Hot Springs. The beautiful unconformability under the sheet of rhyolite which forms so impressive a feature in that landscape stands out with admirable clearness in Mr. Holmes' drawings. Evidence is supplied of the diminution of the Yellowstone Lake. A reference, tantalizingly brief, to the interesting glacial problems of the district concludes this short Report. The author was too well and busily employed with his pencil to find time for much independent geological observation. But it is matter for hearty congratulation that before he was moved away into the vaster domain of the Grand Cañons of the Colorado, where he has since done such service to the United States Geological Survey, he was enabled to spend long enough time in the Yellowstone region to

produce the series of pictorial illustrations which enrich Dr. Hayden's final Report. His trained eye and power of rapid and accurate sketching greatly contributed to the perfection of the map of the Park.

The second and by much the longest section of the book is devoted to the Hot Springs of the Yellowstone Park, and is from the pen of Dr. A. C. Peale, who spent about two months in the district making detailed observations of the geysers and other thermal waters. He describes more than 2000 springs and seventy-one geysers, and illustrates his descriptions with so numerous a series of plates that every minute detail and variety of form in the geysers and sinter accumulations is vividly brought under the eye. Dr. Hayden justly remarks that this preliminary work ought never again to be necessary. Short of an actual inspection of the geysers and basins themselves, nothing could give a clearer idea than these plates do of the extraordinary forms assumed by the deposits from the thermal waters. The strange coralloid and sponge-like aggregations are excellently depicted in lithographs which have obviously been reproduced from photographs. Dr. Peale's Monograph consists of three parts, the first devoted to a description of the geysers and thermal springs; the second to an account of the principal geyser regions of the world for purposes of comparison; the third to thermohydrology, in which he discusses the general characters of thermal waters, their chemistry and deposits, and the theories of geyser action. The premature disbanding of the Survey prevented the completion of this essay on the scale originally intended. But Dr. Peale may be congratulated on having made a most useful addition to the literature of the subject. Not the least of its merits is the copious bibliography which is given in an Appendix.

The third section of the volume, by that able cartographer Mr. H. Gannet, deals with the topography, and gives an interesting *résumé* of the various reconnaissances and surveys which have resulted in the present detailed map of the Yellowstone Park.

The other volume, forming Part I. of the Report for 1878 is divided into two sections. One of these, relating to geology and palæontology, contains a series of Reports by Dr. C. A. White on the invertebrate palæontology of the Western States and Territories from the Carboniferous to the Tertiary rocks, and is accompanied by forty-two Plates of Fossils. Some sections have a special interest, in particular that in which the author discusses the fossils of the much disputed Laramie group, and sustains his previously expressed opinion that this group should be regarded as transitional between the Cretaceous and Eocene formations of the West. The abrupt cessation of the Survey, by depriving Dr. White of an opportunity of completing some of his work by further collection, has materially crippled him in the preparation of these further contributions to a subject which he has already done so much to elucidate.

Mr. Orestes St. John supplies a report on the Wind River District Basin, and Mr. Scudder reprints with additions and alterations the report on the Tertiary Lake-basin of Florissant, Colorado, which has already appeared in the Bulletin of the Survey, and which made known the extraordinary abundance of insect remains preserved in the lacustrine deposits of that locality.

The second section of the volume is devoted to Zoology, and consists of two Reports—one of them an invaluable monograph by Mr. A. S. Packard, jun., on Phyllopod Crustacea, recent and fossil, illustrated with thirty-nine plates and a coloured map showing the zoological provinces of North America. This memoir will be welcomed by all who take interest in the investigation of genealogies and of the history of distribution in the animal kingdom. Dr. R. W. Shufeldt concludes the volume with an essay on the osteology of various American Birds, likewise copiously illustrated with woodcuts and with lithograph plates.

From this outline it will be seen how well Dr. Hayden has sustained to the last the character of the Survey under his charge. During his tenure of office he proved himself to be endowed with rare powers of organization and administration and to possess wide views of the scope of a survey which, like his, was to break ground for the first time in new and unknown territories. He might have been simply an explorer, anxious to find out the sources of rivers, the positions of passes, the heights of peaks, and the trend of mountain-ranges. He might have been a mere geologist, desirous of adding some thousand miles of new area to formations already known or of discovering formations such as have no precise parallel elsewhere. He might have been only a topographer, caring chiefly for the accuracy of his triangulations and levellings. He might have been a botanist or zoologist, eager to add new species to the known flora and fauna of the earth's surface. In one sense Dr. Hayden was none of these; in another sense he combined the functions of them all. In later years his executive duties appear to have left him little opportunity for carrying on original research himself. But he had sympathy with all the pursuits just named, and had the faculty of choosing good men for prosecuting them. He had force of character enough to succeed in battling his way and getting his appropriations from Congress, and he had the perseverance to press forward his operations, keeping his fellow-labourers together and publishing with their aid a series of volumes of which the United States may well be proud.

The consolidation of the various Surveys under one organization was an inevitable and entirely justifiable step on the part of Congress, and the United States Geological Survey could not be under more energetic and skilful direction than that of its present estimable chief, Major Powell, with the cooperation of such leaders in geological enterprise as Mr. Gilbert, Captain Dutton, and their colleagues. Nevertheless, it may be permitted to a geologist on this side of the Atlantic, who looks disinterestedly but not unsympathetically upon the progress of events on the other side, to express his regret that it should not have been possible to find a place where scope might have been afforded for the talents of one who had done such good service to geology as Dr. F. V. Hayden.

ARCH. GEIKIE

OUR BOOK SHELF

Attraction et Gravitation d'après Newton. Par Mme. Clémence Royer. Extracted from the Review "*Philosophie positive.*" Pp. 23. (Paris, 1883.)

It is very surprising to find what is, in most other respects, a really well-written and able dissertation on

the question of *action at a distance* marred at the very outset by an almost inexplicable blunder.

Madame Royer has evidently read much, and lays down with great clearness the distinction between Newton's Theory of *Gravitation* as a mode of grouping together under one simple law the whole phenomena of physical astronomy, and the assumption handed down from old Greece, of a mutual *attraction* exerted upon one another by any two portions of matter. She shows that Newton everywhere expresses himself in the most explicit terms against the notion of distance-action. But she also points out the curious distinction between Newton in the *Principia*, the pure mathematician and physicist, who constructs no hypotheses and declares that the mode in which gravitation is produced is one which he has not been able to discover from the phenomena themselves; and Newton in his *Optics*, the bold speculator, who discusses the possible characteristics and properties of the medium by which gravitation may be produced.

This is, on the whole, so well done that we are positively amazed to find the all-important property of matter, *Inertia*, absolutely and entirely ignored. From a psychological point of view, the following remarks, by such a writer as Madame Royer shows herself to be, are of the very highest interest and curiosity:—

"Qu'est-ce en effet que la notion de *masse*, si ce n'est celle d'un corps déjà considéré comme pesant? Un corps sans pesanteur serait-il une masse? en aurait-il les propriétés mécaniques? Une masse, supposée absolument isolée dans l'espace, aurait-elle un poids? Evidemment non, puisque le poids ne naît que des rapports de grandeur et de distance des masses. Dire que le poids ou la masse est proportionnel à la quantité de matière ou de substance, c'est affirmer une chose que nous ne savons pas, que nous ne pouvons absolument savoir d'aucune manière. Tout ce que nous savons c'est que, considérant des corps déjà pesants, en vertu de leurs relations de quantité et de distance, leur pesanteur croît en raison de ces quantités et en raison inverse de ces distances, sans que leurs quantités, comme matière, soient altérées, de façon que des masses doubles ont une tendance deux fois plus forte à tomber l'une vers l'autre, ce qui fait qu'elles s'approchent en réalité avec la même vitesse (*sic*), et que si leur distance devient moitié moindre, elles s'approchent quatre fois plus vite l'une de l'autre.

"Mais comme l'unique moyen que nous ayons de mesurer la grandeur de ces masses est de les peser, nous restons dans l'impossibilité absolue de dire si des masses de même poids, en même relation de distance avec d'autres masses pesantes, contiennent, oui ou non, la même quantité de matière."

Evidently Madame Royer, in reading the *Principia*, has failed to notice, not only the definition of *Vis insita* but also, those important pendulum experiments by which Newton satisfied himself of the exact proportionality of weights to masses, in any one place. Here we see, in no doubtful manner, the evil effects of an education in which athletics have no part. No one, man or woman, who has had experience of Indian clubs or of dumb-bells, could for a moment doubt that we have another mode of distinguishing mass, besides weighing.

Electrotechnisches Jahrbuch von der Electrotechnischen Gesellschaft in Frankfurt am Main. (1883.)

ALL over Germany are springing up electrotechnical societies, in emulation of those in Berlin and Vienna, fulfilling a kindred part to that played in Great Britain by the much older Society of Telegraph Engineers and Electricians. The volume published by the Frankfurt Society—the first of its *Proceedings*—contains several papers of interest. Amongst these may be noticed two by Dr. Th. Stein of Frankfurt, on the measurement of small intervals of time by the photographic electric method; and on certain modern electro-chirurgical apparatus, especially modifications of the influence-machine of Holtz. In the first of these papers Dr. Stein describes an apparatus for photographing the pulsations of the heart, &c., as conveyed by a Marey's tambour to an apparatus which at